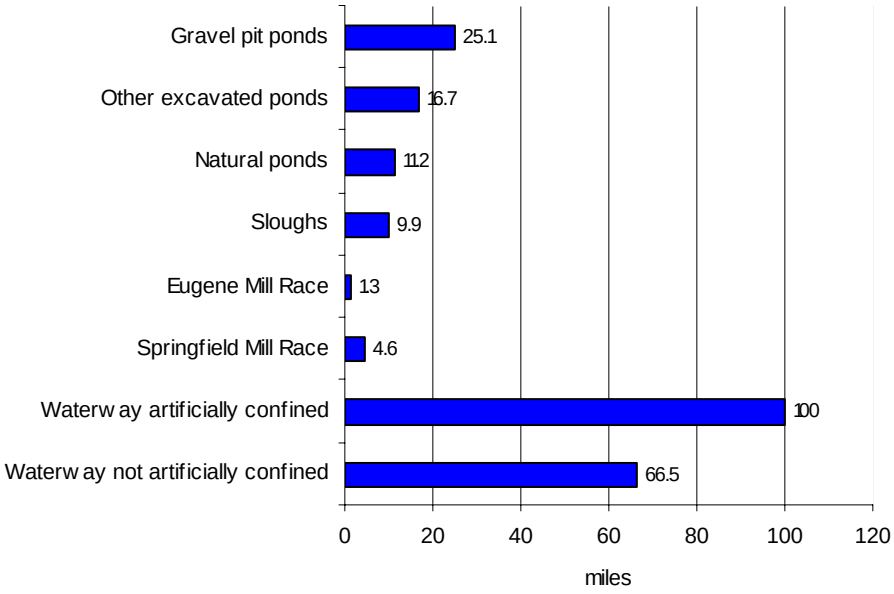


**Figure 13. Lengths and perimeters of study area water types excluding rivers and their side channels and alcoves (miles).**

### 2.2.3 Channel size

Channel size is an indicator of the amount of living space available to fish. It can also indicate whether or not the stream has water during the dry season since most small streams in the southern Willamette Valley dry up during the summer. Maps prepared by the Oregon Department of Forestry (ODF) and Oregon Department of Fish and Wildlife (ODFW), which note breaks between stream size classes based on average annual flow, were used to assign stream size to the waterway reaches examined in the study area. Average annual flow can be estimated using an empirical relationship that takes into account upstream drainage area and average annual precipitation. Since sloughs and mill races do not have defined watershed boundaries within the ODF/ODFW system and were therefore not assigned a channel size, their size class was determined by observation in the spring, a time when flows approximate average annual flow.

Nearly 80% of the length of waterway not artificially confined and 73% of the length of waterway artificially confined were in the small size class. The Springfield Mill Race was medium-sized and the Eugene Mill Race was all small-sized. Sloughs were divided among the three size classes (Figure 14). Within the Willamette Valley, most small-sized streams dry up or have water levels low enough to inhibit adult fish passage during the dry season. Therefore, asuming that most of the study area's small streams dry up by late summer, a relatively small portion of the area's waterways would be capable of providing year-round fish habitat.

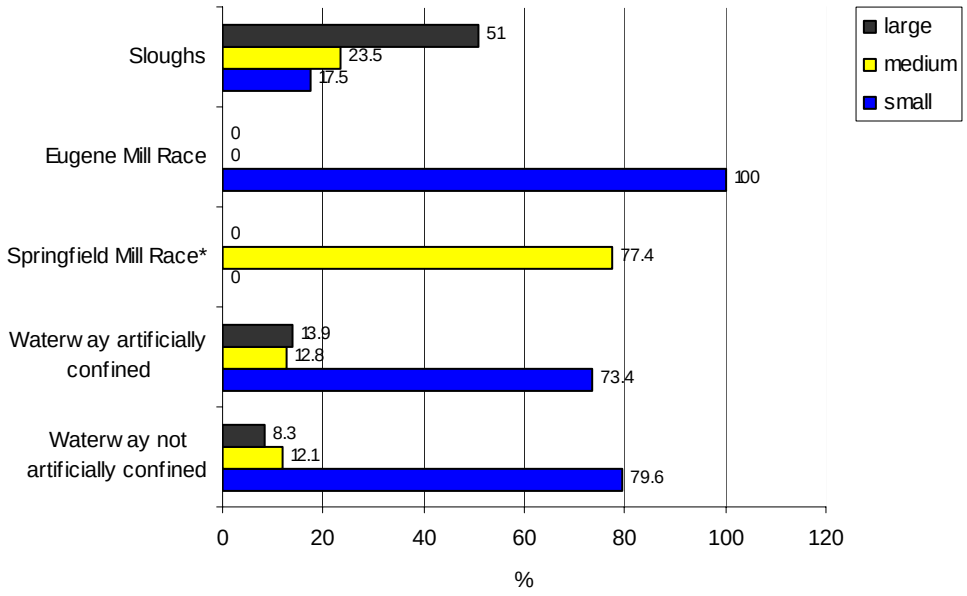


**Figure 14. Channel size distribution percentages for four water types by length, excluding rivers and their side channels and alcoves.** *22.6% of the length of the Springfield Mill Race is composed of the Mill Pond which was not assigned a stream size.

### 2.2.4 Channel confinement

Channel confinement influences a channel's connection to its floodplain. A channel reach that has been excavated deeply in order to increase its flow capacity has limited potential to interact with its floodplain. In contrast, a channel that regularly overtops its banks and meanders across the floodplain often develops features that are favorable for fish. These features include:

- Refuge and escape from high velocities
- Greater access to terrestrial food sources
- Potential for increased variety in substrate
- Side channels and alcove formation
- Capture of large wood

Artificial confinement of waterways in the study area is largely a result of excavation (Table 18b). The length of waterways lined with concrete or bordered by fill material is relatively small.

**Table 18b. Length of confined waterways by type of artificial confinement. Includes streams, mill races, sloughs, ponds, gravel pits and other channels.**

| Type of artificial confinement | # miles |
|---|---|
| Excavated | 106.3 |
| Lined with concrete | 3.2 |
| Bordered by fill material | 3.5 |

Artificially confined waterways are most common in the Amazon Creek watershed, Santa Clara area, Q-street floodway, and the North Beltline Floodway. Other major tributaries, such as Cedar Creek, Willow Creek, Pudding Creek, and Russell Creek and sloughs such as Patterson Slough, Jasper Road Slough, and Dodson Slough have mostly channels that are not artificially confined. The two mill races were created from historic natural water courses. However, whereas the upper Springfield Mill Race retains its natural confinement features, its lower half and all of the Eugene Mill Race have been excavated. The Eugene Mill Race also has a section of concrete bank confinement on it.

### 2.2.5 Channel bank material

The material comprising the bank of a water body can influence the quality of fish and wildlife habitat. Channels with natural material are usually convoluted with small pockets that provide slack water and niches for fish and their food supply. In contrast, channels bordered with foreign material such as fill, riprap, and concrete are not favorable habitat for fish and wildlife, although some species of fish, such as redside shiner, are attracted to riprapped banks with their many small hiding areas.

Nearly all banks in the study area consist of natural material (Figure 15, Map 6). Portions of banks along middle Amazon Creek between 24th Street and the County Fairgrounds, the Q-street floodway between 10th and 16th Street, 72nd Street Channel, and the Eugene Mill Race are lined with concrete. Mill races also have more riprap along their banks than other waterways. Overall, riprap along non-river waterways is scarce compared to the amount bordering rivers.

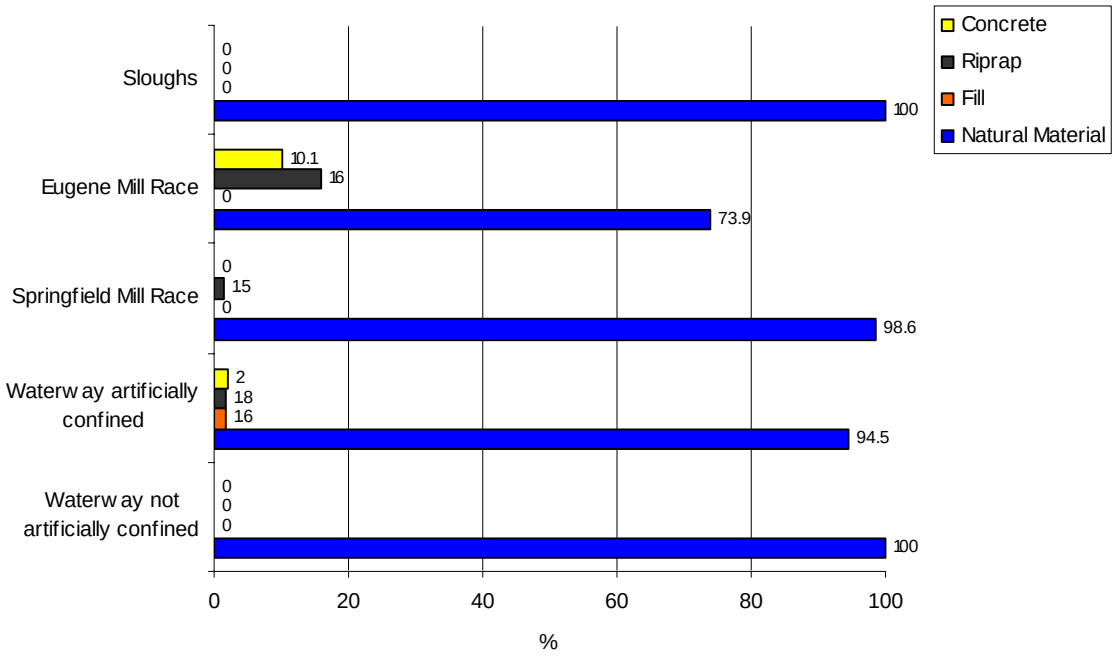


**Figure 15. Bank material distribution along four water types (% of total bank length).**

### 2.2.6 Geology

The geology over which a water course flows can influence the quality of habitat for fish and other aquatic organisms. As discussed in Section 1.1, the study area has three primary geologic formations; basalt geology, Missoula flood deposits, and river alluvium (Map 5). Stream reaches in basalt geology usually have a steeper gradient than reaches elsewhere in the study area. They will also often have a coarser substrate which promotes the colonization of aquatic insects. Furthermore, because the fractured basalt geology is capable of holding water into the dry season, these reaches tend to experience an influx of cold water during the summer.

The Missoula flood deposit geology, which sits between the basalt geology and the river alluvium, probably offers the least favorable habitat for fish and other aquatic organisms. The bank and bed material is fine-textured which limits the available habitat for aquatic insects and causes them to receive little subsurface flow during the summer.

Stream reaches in the river alluvium geology type often benefit from subsurface river flow that can supplement channel flow and provide cool water during warm summers. Since the rivers have previously scoured away the fine Missoula flood deposits, the substrate often consists of gravel and cobbles, which is favorable for aquatic insects and fish. During floods, these channels fill with river water and become zones for fish to find refuge from fast water.

Field visits of individual stream reaches to map the breaks between the three geology types. This worked well when defining the break between basalt and Missoula flood deposits. The break between Missoula flood deposits and other geologic formations was often less clear since small channels sometimes flowed across remnant patches of the Missoula flood deposits that had not been scoured away by the rivers.

We overlaid delineations from the USGS geology map with the field observations (Map 5) and found they were in general agreement. Where they differed we usually let the field observation determine the geology of the stream reach.

Most waterways flowing over basalt geology or Missoula flood deposit geology were small, while waterways flowing through river alluvium geology were divided among the three size classes (Figure 16).

While the basalt geology streams would normally have high quality habitat from fall to spring due to their gradient, substrate, and groundwater inputs, these reaches are probably intermittent during the summer. Fish inhabiting these waters in the spring need to escape downstream to larger system reaches where water is cooler and abundant year-round. Because of limited groundwater exchange in the Missoula deposit geology, cool water would more likely be found in the medium and large alluvium geology reaches or in the rivers rather than streams in the Missoula flood deposit reaches. Blockages to downstream fish movement rarely occur since fish can withstand large drops in channel elevation.

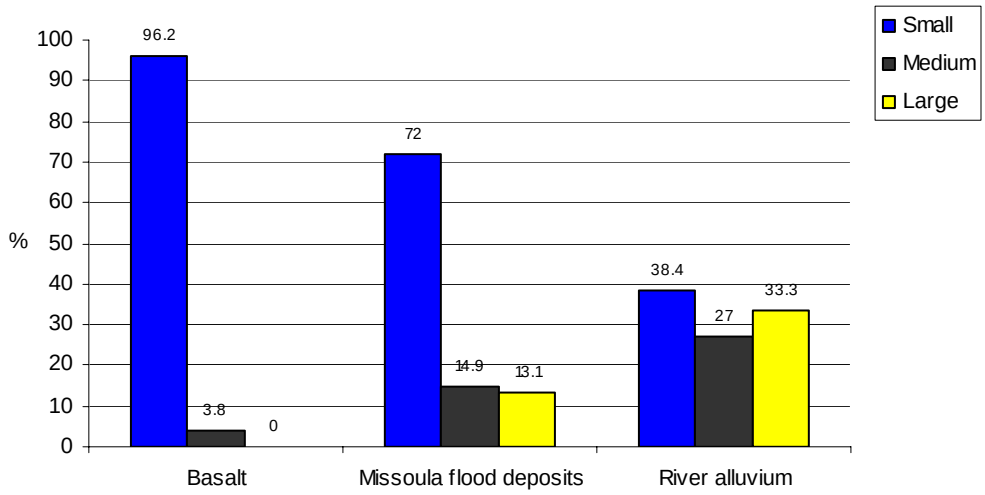


**Figure 16. Geology type by stream size class (% of total length).**

## 2.2.7 Overall physical condition of non-river waterways

We constructed a simple model of how we thought the channel characteristics discussed above relate to overall fish and macroinvertebrate habitat for waterways (Table 19a). The amount of impervious surface within each sub-watershed was also added to reflect the effects of increased peak flow and other stormwater influences on habitat (Map 13). Each parameter category was assigned a subjective position along the scale between highest habitat quality to lowest habitat quality. For example, the three geology parameters are positioned so that river alluvium provides the highest quality and Missoula flood deposits the lowest quality. The basalt geology was intermediate but more similar to the river alluvium than the Missoula flood deposits. For lack of qualitative information, we assumed that each parameter contributed equally to fish habitat quality. Other aspects of fish habitat, such as abundance of large wood, are not included in this table due to the lack of information. In general, when viewing streams in the study area, the observation is that large wood was scarce.

Reaches of waterways were searched for that had combinations of parameters which pointed towards the highest habitat quality or lowest habitat quality using Table 19a as a rule.

**Table 19a. Highest and lowest quality habitat assignments for five parameters that define channel condition.**

| Parameter | ***Highest habitat quality*** | | | | | ***Lowest habitat quality*** |
|---|---|---|---|---|---|---|
| Stream size<br>Summer<br>Otherwise | Medium<br>Medium | Large<br>Small | | Large | | Small |
| Channel confinement | Not confined | Confined (hill slopes) | Confined (high banks) | Confined (fill material) | Bermed | Excavated |
| Bank material | Natural | Fill material | Riprap | | | Concrete |
| Geology | River alluvium | Basalt geology | | | | Missoula flood deposits |
| Impervious surface | 0-25% | | 26-45% | | | >45% |

Pudding Creek was the only medium sized, non-confined, natural bank material, river alluvium waterway in the study area, indicating that its reaches present high quality fish habitat. When the query was expanded to include large sized waterways, Cedar Creek, the Jasper Road Slough, the canoe canal and Patterson Slough, and the confluence section of Dodson Slough with the Willamette River were also identified as having combinations of channel features that consistently pointed towards high habitat quality. Nevertheless, this ranking considers only physical habitat conditions. Water quality conditions (as discussed in the next chapter) may trump physical conditions in some of these waters.

Reaches in the upper Amazon Creek and Willow Creek basins, Russell Creek, Laurel Hill Creek, 75$^{th}$ Street Creek (which flows north into Gray Creek), Debrick Slough, Keizer Slough, and Thompson Slough along the Middle Fork also emerged has having the potential for high quality fish habitat when the query was expanded to include small sized streams and waterways situated on basalt geology.

Headwater reaches of Amazon and Willow Creek have high fish habitat quality characteristics. However, particularly in Amazon Creek, these reaches are isolated from the lower channel reaches by disconnected channels (piped subsurface for long distances). Efforts to improve habitat for fish in these reaches may be of low priority since fish have no way to re-populate these reaches after they dry up in the summer.

The Q Street Floodway stretch between 10$^{th}$ and 16$^{th}$ Streets and Amazon Creek between 24$^{th}$ Street and the County Fairgrounds exhibited the lowest quality fish habitat in the study area.

Few reaches in the study area actually are influenced by concrete banks. By adjusting the query to not select reaches with this bank characteristic, many more reaches were highlighted as having potentially low fish habitat quality based on small stream size, excavated channels, and a Missoula flood deposit geology. All the small channels in the lower Amazon Creek basin, the Santa Clara area including portions of Spring Creek and Flat Creek, Quarry Creek, the east-west portion of Gray Creek, the 69$^{th}$ Street Channel, SCS Channel #6, the 48$^{th}$ Street Channel, Gilham

Creek, the Q Street Floodway, and the North Beltline Floodway were identified as having poor fish habitat quality.

### 2.2.8 Piping of urban streams

Though not surveyed, it became clear from aerial photos, GIS layers, and observed stormwater pipe outlets along surveyed streams, that an important consideration in channel and riparian condition within the study area is the re-routing of headwater and mid-reach surface flow into underground pipes. A large number of channels in the headwater hills and on the valley edge have been buried and piped as the need for land to develop has increased. The surface headwater channel to mid-order channel network in Upper Amazon Creek and the South Eugene Hills area, for example, has been severely dissected (Map 7). Most of the middle channel reaches are now routed underground and emerge, often dramatically, in the lower larger streams. As development has crept farther upslope in the upper South Eugene Hills area, it is highly likely that numerous spring outlets have also been buried or interrupted.

Effectively removing mid-headwater reach channels from their surface interaction has ecologic and hydrologic consequences. Historically, these reaches were sources of large wood to the channel systems on the valley floor. This function has been eliminated, leaving valley floor streams without the structural input and ecological function that large wood contributes. From an ecological habitat perspective, headwater reaches also add nutrients, contribute bedload and sediment which replenishes lower channels, and support large communities of macroinvertebrates. These important sources that replenish and feed lower stream reaches are not available, adding to the difficulty in promoting fish habitat in lower non-river reaches.

Hydrologically, the piped channels collect and focus flow in larger volumes than might have historically been routed downstream because connections between floodplain, groundwater exchange, and transpiring vegetation have been removed. During field surveys, residents on Augusta Avenue in Eugene, north of 26$^{th}$ Street, recounted the extremes in flow observed from an underground piped channel that emerges at the top of their property. The pipe is a 24 inch cement round culvert and drains, according to the residents, a 250-acre area above them that has been developed over the past five years. Prior to the increase in development, the residents did not recall unusual flow emerging from the pipe. However, during recent first September/October storm events, flow emerging from the pipe filled the entire pipe and carried such force that it shot thirty feet through the air before striking a boulder revetment the residents installed downstream.

This particular instance, brought to the attention of the assessment team by chance encounter, illustrates the importance of thoroughly assessing and re-assessing impervious surface layer basin position and extent. A disconnect between watershed headwater reaches and lower reaches combined with the re-routing of flows from groundwater storage across impervious surfaces and into subsurface pipes has significant implications for downstream channel restoration and waterway maintenance efforts. Both Eugene and Springfield city planners have an opportunity to proactively address the influence and effects of future development on:

- Natural springs

- Subsurface flow interruption
- Design of channels and/or development around surface channels
- Selection of pervious surface construction materials in areas that currently serve as groundwater storage areas
- Connectivity of waterways from headwaters to river confluence

### 2.2.9 Channel condition summary

The channel condition of non-river waterways within the study area is, in part, a factor of underlying geology, channel size, channel confinement, and bank material. Factors such as gradient play a very minor role because, other than within the basalt geology reaches in the Upper Amazon basin or the South Eugene Hills, channel gradients are uniformly low. The geologic character of a reach and its influences on fish habitat provides a better descriptor of channel condition response.

As a determinant of fish and macroinvertebrate habitat quality, basalt and river alluvium geologies provide higher quality habitat than the Missoula flood deposit geology. Unfortunately, the waterway reaches flowing over basalt formations have been, for the most part, disconnected from the lower waterway reaches by either water quality barriers or physical barriers such as underground piping of channels and development. The reaches flowing over basalt geology are also generally small in size, further limiting their year round potential for fish habitat.

The channel reaches running over river alluvium (Map 5) offer the best potential for fish habitat in the study area. They are close to the groundwater flow influences of the river systems and their substrates provide a diverse habitat for aquatic macroinvertebrate colonization. These reaches also tend to have the greatest proportion of medium and large-sized channels which increases their ability to provide year round fish use. Unfortunately, because of peak flow moderation from the reservoirs and urban stormflow management, the length of available habitat within this scour-dependent geologic type is limited.

The Missoula flood deposit geology is the predominant geologic type in the study area and sits between the river alluvium and basalt formations. It is also the geologic type most affected by urbanization and agriculture. At one time, the Missoula flood deposit geology likely offered a rich refuge during high flows for fish; providing while flooded, slower velocities and food sources of submerged terrestrial plants and insects. As high flows receded, these rich flood deposits contributed nutrients to the stream and river systems while eroding to provide new areas of river alluvium. Currently, however, the Missoula flood deposit geology offers low quality fish habitat because its fine sediment substrates provide limited habitat potential for aquatic macroinvertebrates and it remains disconnected from its floodplain by controlled flows and management history of excavation. Though many small-sized channels cut through Missoula flood deposits, there are more medium and large-sized channels than in the basalt formation. These could, depending on many other factors, provide year round fish habitat.

Channel confinement is a defining and limiting factor in the watershed function of the study area. Artificially confined channels make up just under half of the non-river waterways and of these,

over 90% are confined by excavation. As a result, approximately half of the non-river waterways are separated from their floodplains. However, because most of the non-river waterway banks within the study consist of natural materials and only small portions are currently affected by riprap or concrete, opportunities to easily reduce channel confinement are possible.

### 2.2.10 Riparian vegetation and land use

Riparian vegetation contributes directly and indirectly to fish habitat quality. In its various forms, riparian vegetation has the potential to:

- Moderate stream and air temperature and humidity
- Contribute detritus used by macroinvertebrates which are then incorporated into stream nutrient cycling
- Secure stream banks with roots, thereby reducing bank erosion
- Filter groundwater for pollutants
- Contribute large wood that adds to stream structure and fish habitat
- Create habitat diversity for fish, amphibians, mammals, insects, and birds

Riparian vegetation in the study area is relatively diverse. The diversity is a function of the variety of landforms and land uses found within the study area.

During late winter and early spring 2002, vegetative and land use characteristics for all waterway reaches (except river reaches) accessible from public land, roads, or private invitation were surveyed. The remaining waterway reaches were surveyed using aerial photos. Riparian vegetation by type, cover, and land use assessments made in the field were used to verify vegetation calls made on the aerial photos. Parameters and classes are shown in Table 19b.

Table 19b. Vegetation characteristics assigned to each non-river reach.

| Parameter | Classes | Comments |
|---|---|---|
| Vegetation type | Gravel bar<br>Grass/weeds<br>Ornamental landscape / mowed lawn<br>Blackberry, reed canarygrass, or other aggressive exotics<br>Short native deciduous species, brush<br>Hardwoods <40 years old<br>Hardwoods >40 years old<br>Conifers <40 years old<br>Conifers >40 years<br>Crops (grass seed most common)<br>Orchards (filberts most common)<br>None-soil<br>None-paved lot or road<br>None-gravel lot or road<br>None-buildings | Vegetation growing within 50 feet of water's edge for waterways and 100 feet for rivers and ponds. Each side of a reach is inventoried separately. An included vegetation type must occupy at least 25% of the area, as viewed from the air so up to four vegetation types were allowed per reach per bank. |
| Vegetative cover | 0-33%<br>34-66%<br>67-100% | Percent vegetative cover over water |
| Land use | Residential yards<br>Roads / railroad<br>Buildings<br>Industrial<br>Public park, open space<br>Other undeveloped, urban<br>Gravel extraction<br>Agriculture<br>Forestry<br>Other undeveloped, rural<br>Parking lots<br>Golf course | Determined for each side of the reach. This is the actual use not the zoned use. |

*Riparian vegetation*

Grass and weeds was the most common riparian vegetation class along non-river waters (Figure 17). The community structure of this class is similar to the wet seasonal prairie that historically occupied hydric areas next to waterways. However, the species composition between the two differs significantly. Much of the current grass community is comprised of reed canary grass (*Phalaris arundinacea*), an invasive exotic that colonizes rapidly and competes against native grass species or mowed introduced grass species.

Some current urban vegetation management practices may encourage the persistence of grass and weeds while discouraging the growth of native species, especially shrubs and trees such as willow, cottonwood, bigleaf maple and alder. Amazon Creek riparian vegetation, for example, is managed by mowing the upper banks and bank tops (Guay et.al. 2000). Channels and ditches flowing alongside roads, parks, and residential or commercial lots are commonly managed by mowing or other control measures for safety, aesthetic, or pest control reasons.

The most common overstory vegetation class is hardwood trees younger than 40 years (Figure 17). Based on field survey observation, Oregon ash, cottonwood, and red and white alder make up most of this vegetation class along with non-native trees planted in residential areas.

Native and exotic shrubs make up the second most frequently observed riparian vegetation class (V2) in the study area. This might be expected because shrubs can be present in the understory of hardwood riparian habitats and as the overstory in communities with no tree overstory. The most common native shrub species are willow species, rose, and snowberry. The most common exotic shrub species are Armenian blackberry and Scotch broom. In exotic shrub communities, Armenian blackberry often form extensive monocultures where few other plants survive under its dense clumps. The reproductive strategies of Armenian blackberry include extensive seed dispersal via wildlife and aggressive runner growth. These allow it to rapidly increase its coverage and prevent easy eradication.

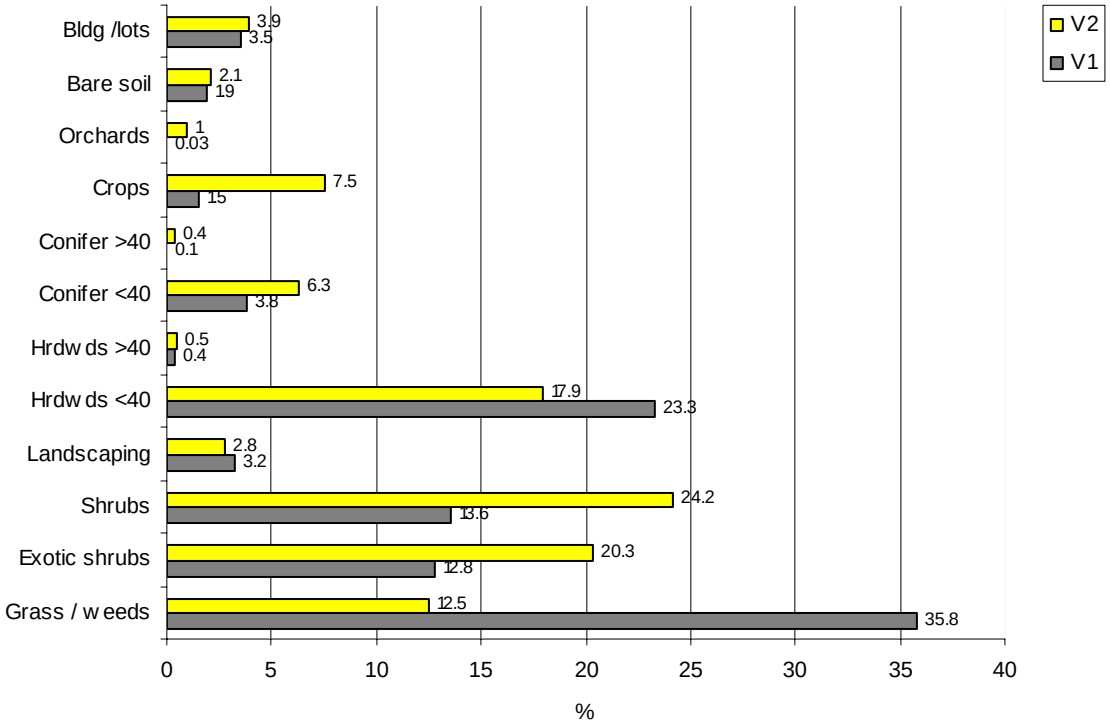


**Figure 17. V1 (most common) and V2 (second most common) vegetation classes along study area waterways (% of bank miles).**

Predominant vegetation class is not the sole indicator of riparian function or health. Associations of a vegetation classes observed together often more clearly describe how a riparian community could be managed and what its successional path might be. For example, a hardwood dominated riparian stand with an exotic shrub understory might require a different management approach than a hardwood-dominated riparian stand with either a conifer association or a native shrub understory given the same management objectives.

Of the four major vegetation classes, shrubs and young hardwoods and grass/weeds and exotic shrubs were most often associated with each other (Table 20). That is, if one was dominant, it

was likely the other was co-dominant. Grass/weeds, exotic shrubs, and native shrubs were more likely to have bare soil, buildings, or gravel/paved lots next to them than young hardwoods. Shrubs were associated with grass/weeds and, particularly, exotic shrubs. Young riparian hardwood stands were the only vegetation class to be associated with a young conifer component. Young hardwood stands were least likely to have bare soil, buildings, or gravel/paved lots next to them.

**Table 20. Dominant and associated co-dominant riparian vegetation (%) for water types other than rivers.**

| ***Co-dominant vegetation (V2)*** | ***Dominant vegetation (V1)*** | | | |
|---|---|---|---|---|
| | Grass/weeds | Exotic shrubs | Shrubs | Young hardwoods |
| Grass/weeds | - | 35.5 | 12.4 | 6.6 |
| Exotic shrubs | 29.8 | - | 17.4 | 9.3 |
| Shrubs | 11.5 | 38.2 | - | 37.2 |
| Young hardwoods | 13.2 | 11.3 | 36.5 | - |
| Young conifer | 1.1 | 1.3 | 0.5 | 18.0 |
| Orchards/crops | 11.6 | 0.3 | 11.1 | 7.6 |
| Bare soil/bldgs | 6.79 | 6.87 | 6.54 | 0.36 |

Exotic plant species are ubiquitous throughout the study area. Of all the surveyed riparian channel reaches, 40.3% (134.7 miles) contain grass/weeds and 31.3% (104.5 miles) contain exotic shrubs as at least 25% of their cover. Often these communities are highly invasive and difficult to eradicate. The grass/weed category was most often a measure of reed canary grass cover. In addition to reed canary grass, other common invasive species in the study area are Armenian blackberry, purple loosestrife (*Lythrum salicaria*), roughstalk bluegrass (*Poa trivialis*), nipplewort (*Lapsana communis*), and English ivy (*Hedera helix*) (Titus et. al. 1996). Additional invasive species that are relatively new to riparian communities in the Willamette Valley, but should be watched and managed for, include butterfly bush (*Buddleia* ssp.) and Japanese knotweed (*Polygonum cuspidatum*). For a complete list of invasive species compiled by the Native Plant Society of Oregon for Lane County, see their Emerald Chapter website at http://www.emeraldnpso.org/inv_ornmtls.html.

*Canopy channel cover*

Percent canopy channel cover can offer insight into both the vertical structure of the riparian community and the exposure of the waterway to solar radiation inputs which causes increases in water temperature. Over 70% of non-river reaches had less than 33% cover. Only 13% of study area non-river reaches had greater than 67% cover. Waterways not artificially excavated have the highest percentage of heavily shaded reaches and the most balanced distribution of cover (Figure 18).

Natural ponds, constructed ponds, and gravel pits have large areas of surface water that riparian vegetation on their borders cannot shade. Cover percentages will naturally be lower on these systems. Natural ponds did have slightly more cover than constructed ponds.

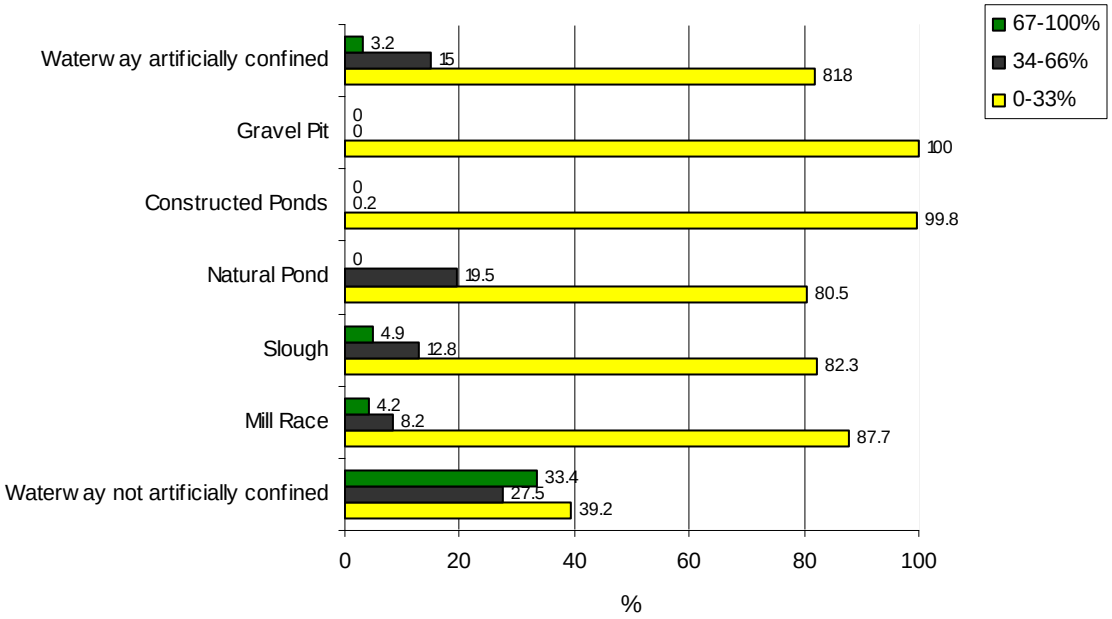


**Figure 18. Canopy cover class for the various water types (% of length).**

Waterways that were artificially confined, sloughs or natural ponds, rarely had much overhead cover. Though they are similar to waterways that are not artificially confined, their management and associated land uses tend to be different. They tend to be next to roads or other developed areas and are managed to convey water during the rainy season.

*Adjacent land use*

Despite the urban focus of the assessment and urbanization's influences on many of the study area waterways, more channel miles are bordered by agriculture than any other land use (Figure 19). Other land uses that affected more than 10% of total bank length were residential, undeveloped urban, and undeveloped rural (Figure 19, Map 8). The majority of waterway banks in the study area (58%) are bordered by land uses that are not associated with development (public land/parks, undeveloped urban, agriculture, forestry, and undeveloped rural).

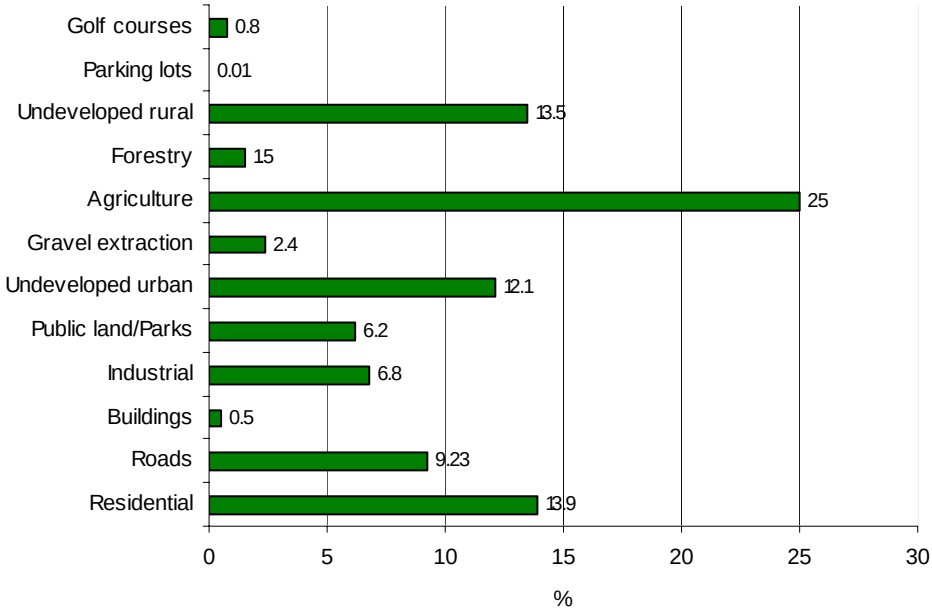


**Figure 19. Dominant land use categories adjacent to study area waterways (% of bank length).**

Certain riparian vegetation types are commonly associated with specific land uses along waterways. Figure 20 illustrates the primary vegetation types found in or next to each of the seven major land use categories along study area waterways. The criteria for selecting a "primary" vegetation class was that it had to be present along at least 15% of one (not all) major land use category.

In the undeveloped rural areas, hardwoods form the dominant riparian vegetation type. The emerging pattern of grass/weeds being less prevalent in this area, while hardwoods and shrubs are more dominant, illustrates a shift from historic vegetation patterns. This shift is likely a result of the absence of fire and the introduction of successfully adapted species.

Grass is the most common riparian vegetation type for residential areas, roads, undeveloped urban areas, and agriculture (grass seed fields were counted as agriculture). Riparian areas next to roads and agriculture fields will likely always associate with a high amount of grass because of safety considerations and crop selection. However, there may be flexibility in residential and undeveloped urban spaces to diversify this riparian vegetation community. Community education and action efforts would be drivers for this change.

Residential, undeveloped urban, and undeveloped rural land uses adjacent to waterways have the highest percentages of young hardwoods among all land use categories. As expected, grass/weeds are common in all the land use categories. Interestingly, however, this grass/weed community is lowest along undeveloped rural waterways where lack of management might be assumed to encourage its development.

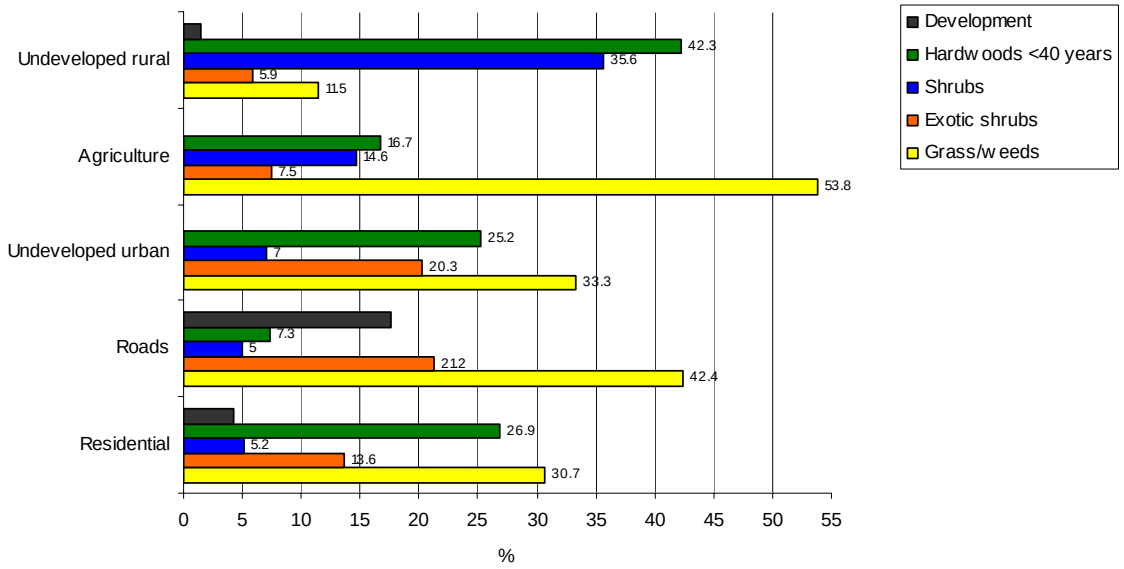


**Figure 20. Riparian vegetation classes associated with seven major land uses adjacent to study area waterways (% of total length).**

## 2.2.11 Riparian conditions by water feature

Based on the general data interpretation completed above, certain patterns in riparian vegetation, channel form, and potential fish habitat begin to emerge. Though interesting and useful in describing the study area as a whole, summaries of study area riparian areas generated from lumping data into gross categories do not move managers much closer to understanding their management area or developing useful action plans. To bring the summaries closer to an on-the-ground assessment level, riparian focus areas were created by:

1. Identifying distinct breaks in vegetation, geology, and/or channel type and
2. Overlaying these either within a stormwater drainage area boundary or joining together a number of stormwater drainage areas that encompass homogenous water types.

The following riparian vegetation summaries for non-river riparian focus areas provide an appropriate level of riparian detail for an analysis unguided by specific action plan questions. MECT members are encouraged to query the GIS and field assessment database with specific questions for channel- and/or street-specific information. The collected information is structured to facilitate doing so easily.

*Amazon, Willow and Russell Creek headwaters*

This focus area encompasses the headwater channels within the:

- Willow Creek basin down to the confluence with Amazon Creek (WC on Map 14)
- Upper Amazon Creek basin down to Snell Street
- Russell Creek down to the I-5 crossing (southern-most portion of WR on Map 14)

Channels within these headwater areas with basalt geology are almost entirely designated as "waterway not artificially confined." There are some reaches confined by excavation on Willow Creek within the channel paralleling and just south of 20th Street, from 20th to the confluence, and on a portion of the east fork near the beginning of Gimple Hill Road and on Amazon Creek by Willamette Street and below Martin Street. There is only one observed pond in the Amazon Creek headwaters. It is a spring-fed pond located on a slump in the hillside. Because there are reportedly many springs in the area, more such ponds may exist. Three ponds were observed in the Willow Creek area. Large constructed ponds are found in the Russell Creek area near Lane Community College.

Most adjacent land use in this area consists of parks and other public open spaces, undeveloped urban land, and residences. Public parks and open spaces are primarily along Willow Creek and portions of Amazon Creek. Residences are located primarily along the disconnected channels in the middle headwater reaches of Amazon and Russell Creeks. Development often includes routing creeks, especially smaller ones, subsurface through pipes which break up the channel system. Undeveloped urban land exists primarily in the upper South Eugene Hills and Russell Creek area. However, during the field assessment, new and clearly planned development for this area was observed. It will likely soon transition to residential land use.

Riparian vegetation in this area consists predominantly of an overstory community of hardwood and conifer trees younger than 40 years. Reaches in the lower end of Willow Creek and the riparian area surrounding the ponds at Lane Community College are bordered by a grass/weed community. Grass and weeds also exist as the second most common vegetation type on portions of Willow Creek. There is little to no ornamental landscaping or exotic shrubs within the riparian areas in this region. A small area of exotic shrubs borders the stretch of upper Amazon Creek near Willamette Street where it is also confined by excavation. Exotic shrubs are associated with grass/weed communities around the ponds near the Lane Community College and near the portion of Willow Creek flowing beside Willow Creek Lane.

This predominance of overstory riparian vegetation contributes to the high shading levels observed within these upper reaches; the highest in the study area (Map 9). These upper reaches have consistently greater than 33% vegetative cover over their entire lengths until the waterways leave the basalt geology and transition to Missoula Flood deposit geology and increased urbanization.

Were downstream channel conditions adequate to provide fish an unstressful conduit to these headwater reaches, these reaches would have a high potential to provide good fish habitat, even seasonally, as in Willow Creek. Unfortunately, conditions lower in the basin almost completely prevent this area from being considered viable as fish habitat. It is, however, an important area in terms of nutrient and macroinvertebrate productivity and groundwater storage. The relatively complex communities of riparian area vegetation provide channels with a variety of inputs including wood, detritus, bank stability, and shading.

*Lower Amazon Creek basin*

Once Amazon Creek leaves the headwater reaches, its channel condition becomes fairly homogeneous throughout the rest of the study area until it passes into the West Eugene Wetlands. As a result, we set the upper boundary for the "Lower" Amazon Creek focus area at Snell Street. From here it extends downstream to the study edge boundary. It incorporates all of the Amazon (AM) and Bethel-Danebo (BD) stormwater drainage basins on Map 14. Below Snell Street, waterways making up the Lower Amazon Creek basin are confined. Most channel reaches within the West Eugene Wetlands project have been unconfined so that they can reconnect during high flows with the wetland. Reaches within the West Eugene Wetlands near the edges of the project near roads are confined by channel berming, however, to prevent flooding. Quite a few constructed and natural ponds exist in the center portion of this area

Land use adjacent to the channels in this riparian focus area transitions from primarily parks and public open spaces in the Amazon Park area to industrial near 11th Street, back to a combination of public open spaces near the West Eugene wetlands and then out to agricultural uses at the edge of the study area boundary. Scattered within these dominant land use types are residential yards near 18th Street in Eugene and the Roosevelt Channel and Marshal Ditch. Undeveloped urban land is often located next to the multiple disconnected channels in the center of the focus area between Seneca and Bertelsen Roads.

Descending from the headwater focus area on Amazon Creek, riparian vegetation consists of a transitioning community of hardwoods, mowed grass, and exotic shrubs. At 24th Street, the riparian vegetation is replaced by a cement channel covered by invasive ivies and other exotics. Beginning just west of the County Fairgrounds, the predominant riparian vegetation type becomes grass and weeds, often associated with exotic shrubs as channels spread out toward the study area boundary. Reaches along the West Eugene wetlands, the Amazon Creek Diversion Channel, Beltline Road, the A2 Channel, and the Roosevelt Channel are all surrounded by grass. Historically, this area consisted of wet seasonal and dry prairie vegetation. Grass communities along channels are natural features, though the association with exotic shrubs and the lack of seasonal flooding to encourage more wet-tolerant species is not part of the historic vegetation condition. A young hardwood community is present along the Marshal Ditch. New riparian plantings have gone in alongside the creek widening project near Acorn Street Bridge. However, those currently are not affecting the channel.

As a result of limited overstory species within the riparian community, the Lower Amazon Creek basin has very few reaches with vegetative cover greater than 33%. Reaches that do have greater than 33% cover exist along the Marshal Ditch, where hardwood vegetation was observed, and along isolated reaches in the area between Beltline and Bertelsen and near Royal Street.

The Lower Amazon focus area has been heavily influenced by past flood management actions. Excavation has both created channels where they might not have existed and separated these channels from riparian resources. Development and other land uses have further altered the riparian vegetative community. Nutria are quite abundant along reaches of Amazon Creek which will increase the difficulty of successfully growing shrubs and hardwoods to improve stream shading or water quality. Large projects, such as the West Eugene Wetlands, are likely having

somewhat of an effect on local and downstream water quality. The potential beneficial effects of smaller projects, such as the stream widening project near Acorn Bridge, may, unfortunately, be overwhelmed by the overall detrimental water quality inputs and habitat influences contributed by adjacent land uses and engineered channel features.

*Santa Clara area*

This area includes all of the River Road-Santa Clara (RS) stormwater drainage basin on Map 14. Almost all of the waterways within the Santa Clara area, including the A-1 Channel and the waterways around the airport, are confined. Reaches around the airport are confined by channel berming while the remaining reaches are confined by excavation. Reaches near the northern edge of the study area boundary in the East Santa Clara Waterway and Spring Creek and a few channels running through the agricultural land in the northwest and between 99W N and River Road are unexcavated. Natural and constructed ponds are found in the central industrial area between the NW Expressway and 99W and then out along the western and northern edge of the study area boundary.

The Santa Clara area channels are predominantly surrounded by agriculture. Spring Creek and Flat Creek are closely surrounded by residential land use. Road curvature within housing developments off River Road even mimics the sinuousity of Spring Creek as it winds through one of the larger subdivisions. A small block of undeveloped urban land and industry border channels located below Beltline Road and in between the NW Expressway and 99W.

Likely a result of its high agricultural component, the most common riparian vegetation type in the Santa Clara area is grass and weeds, particularly on the western side of the focus area between the study area boundary and the NW Expressway. Channels in this area run through historically dry or seasonal wet prairies. Hardwoods and other taller overstory species would not be expected. However, as land use transitions from agriculture to residential toward the central and east side of the focus area, grass dominated riparian areas begin to co-exist more often with a dense community of exotic shrubs, such as Armenian blackberry. This vegetation association is not typical of the historic vegetation in the area. In the undeveloped urban area between the NW Expressway and 99W, exotic shrubs also make up the most common riparian vegetation.

Hardwoods younger than 40 years start to form a more important part of the riparian community along reaches of Flat Creek, Spring Creek, and the East Santa Clara Waterway. These areas also contain more ornamental landscaping within the riparian area because of high residential densities.

Shaded reaches exist in segments of Spring Creek and Flat Creek where hardwood trees and shrubs are more common. However, because of the predominance of the grass/weed community in the riparian areas in this area, more than half of the reaches have less than 33% vegetative cover.

The Santa Clara area is basically divided between agricultural and residential areas. Though agricultural channels might have the potential to regain some of their natural flow-controlled processes, they are often ditched and their floodplains tiled. Riparian vegetation is closely

managed and limited in size. Channels flowing through dense residential areas are closely confined by back yards and streets and have very little room to move. They are also heavily influenced by stormwater drainage and nonpoint source pollutants contributed by overland flow. This area has limited potential for healthy fish habitat without significant education and channel restoration efforts.

*Cedar Creek area*

The Cedar Creek riparian assessment area includes the North Cedar Creek (NCC), Weyerhaeuser Outfall (WO), and South Cedar Creek (SCC) stormwater drainage basins on Map 14. All of Cedar Creek is made up of unexcavated channel reaches except for the section within the Weyerhaeuser Outfall. Channels surrounding the 48th Street Channel and Gray Creek are also confined by excavation. A large area of constructed ponds exists as part of the Weyerhaeuser Outfall between Keizer Slough and Cedar Creek.

Land use adjacent to Cedar Creek is primarily agriculture for almost all of its length within the study area. Small reach segments of undeveloped rural land are present beginning at both lower confluences with the McKenzie River, then again significantly just west of 69th Street and then along Thurston Road. Residential land use is common along short reaches of Cedar Creek and along the 48th Street Channel and channels bordering Weyerhaeuser Road (48th Street Channels), 69th Street and 72nd Street.

The most common vegetation classes along Cedar Creek are hardwoods younger than 40 years, shrubs, and grass/weeds. Hardwoods and shrubs are found along most reaches of Cedar Creek. Grass and weeds were observed on channel segments between 69th Street and Weaver Road, along Thurston Road and just south of Thurston Road near 72nd. Grass is also located near the 48th Street Channel. Conifers younger than 40 years are found along reaches near Thurston Road. Exotic vegetation is a primary riparian vegetation class along a small reach of the 48th and Highbanks Channel adjacent to I-105 to the north of a small portion of G Street and the west of 52nd Street. The second most common vegetation type along this particular reach is conifers younger than 40 years. There are also a few isolated reaches with crops and one with an orchard as the primary riparian vegetation type.

Most of the reaches in this focus area have less than 33% cover over them. In particular, a long reach of Cedar Creek around the first lower confluence with the McKenzie River, the 48th Street Channel, and channels along I-105, 68th and 71st Streets have low vegetative cover. However, the predominance of young hardwoods and shrubs as riparian vegetation does create reaches, especially in upper Cedar Creek, with greater than 33% cover. Very few reaches have more than 67% cover.

The Cedar Creek area contains potential for restoration, prevention, and conservation. Residential influences, particularly with current sewage management systems, have the potential to detrimentally affect the excavated channels that flow through neighborhoods and drain into Cedar Creek. Cedar Creek, with its surrounding agricultural land use, has both the potential to experience negative influences such as nonpoint source pollutants, ditching, and tiling as well as the potential for riparian vegetation management and restoration and for providing the creek

room to move to respond to flow processes. The influence of the nearby McKenzie River cannot be underestimated. Groundwater exchange between the two systems is likely quite prevalent and the potential for fish use from the McKenzie is obvious. Riparian vegetation and water quality should be managed with fish habitat parameters in mind in most decisions relating to this area.

*Willakenzie*

The Willakenzie area is a fragmented area from the perspective of its non-river waterways and their riparian function and interaction. This region encompasses the Willakenzie (WK) stormwater drainage basin on Map 14. Channels within this area are primarily excavated and disconnected from each other except for the major floodways. This area contains constructed ponds and abandoned and active gravel mining pits primarily along its western border.

This area contains a wide variety of land uses. Roads influence the North Beltline Floodway, Q Street Floodway and channels associated with Debrick Slough. Industry abuts portions of the Q Street Floodway north of Patterson Slough and the Canoe Canal and channels associated with Debrick Slough just west of the Delta Highway. Residential land use borders channels coming off the northwest side of Debrick Slough, by Green Acres Road, and north of Cal Young Road. A golf course north of 105 with some channel influence also defines this focus area.

Associated with the wide range of land uses are a diversity of riparian vegetation types discontinuously scattered throughout. The most common vegetation type is exotic shrubs. Reaches where this vegetation type is predominant exist along the North Beltline Floodway, the Q Street Floodway, and near the Delta Highway. Ornamental vegetation used in landscaping is also a common dominant riparian vegetation class. These vegetation classes are associated with residential areas and the golf course. Young hardwoods and shrubs exist in isolated channel reaches along Debrick Slough, the North Beltline Floodway and the Q Street Floodway as second most common vegetation types. Young hardwoods are far less common as the dominant riparian vegetation class along channels in this area. Grass and weeds are also not often the predominant vegetation type.

Many of the fragmented channels, the Q Street Floodway and the western portions of North Beltline going into Dodson Slough have less than 33% cover. The eastern portion of the North Beltline Floodway, fragmented channels in the center of the area, and the confluence channel of Debrick Slough with the Willamette River have between 33% and 67% cover. Some of that cover is provided by dense exotic shrubs rather than a tree overstory. The north/south oriented reaches of Gilham Creek have greater than 33% cover. A center section has greater than 67% cover on this creek.

Bordered on two sides by the Willamette River and the McKenzie River and containing a number of sloughs, the Willakenzie area has the potential to offer off-channel fish habitat for species using the Willamette and McKenzie Rivers. To maintain and/or create clean, healthy water and potential habitat for these fish, riparian areas along channeled waterways could be managed for communities that include a diverse overstory and understory of native plants. Historically, this area likely consisted of a mix of gallery ash forests and upland and wet seasonal prairie (Map 3). Managing for riparian vegetation communities that mimic these characteristics

in the appropriate areas (i.e., gallery forests, or at least overstory older hardwoods, alongside the larger rivers) would be an excellent goal for this diverse, multiple land use influenced area.

*Q-Street Floodways*

This region includes the West Springfield Q Street (WSQ) and Q Street Floodway (QSF) stormwater drainage basins on Map 14. Channels within this area are all confined by excavation. The area contains three constructed ponds in the northeast corner of the area just south of the Irving Slough.

Roads are the predominant land use within riparian areas in this focus area. Channels abut most of Q Street and along Interstate 5. Industry affects channels north of Highway 126 that flow into Irving Slough and channels between 28th Street, Olympic, and Highway 126. Residential land use borders the Q Street Floodway and SCS Channel #6 in the western half of this focus area. There is a very small area of park and public open space adjacent to the Q Street Floodway between Pioneer Parkway and 5th Street. There is no agricultural land use and very little undeveloped rural or urban riparian land.

The Q Street Floodway and the SCS Channel #6 are almost entirely bordered on at least one bank by riparian vegetation consisting of grass and weeds with a subdominant community of exotic shrubs. One reach of the Q Street Floodway has no riparian vegetation and consists of a paved road. Exotic vegetation makes up at least one bank's primary riparian vegetation from Pioneer Parkway to Interstate 5. The channel extending north along Interstate 5 (I-5 Gateway Channel) toward the North Beltline Floodway has shrubs along it. Only a single small reach on Marcola Road just south of its junction with 42nd Street contains a riparian stand with young hardwoods as the most common vegetation type. Young hardwoods make up a secondary riparian vegetation class along channels running into Irving Slough and near the 105/I-5 interchange.

The entire length of the Q Street Floodway within this area has less than 33% cover over it. Many reaches along the North Beltline Floodway also have less than 33% cover as do channels feeding into Irving Slough. The only channel reach to have greater than 33% cover is the curved reach adjacent to the 105/I-5 interchange. This cover is provided by a shrub community with some associated grass and young hardwoods.

Though relatively disconnected from rivers, the channels within this area do feed into the Willamette River and various sloughs that link to the major rivers. Water quality maintenance is a concern. Because of the structure of the channels, the lack of a diverse riparian vegetation community, and the associated land uses, it is unlikely that either the Q Street or North Beltline Floodways would be capable of supporting viable salmonid populations. However, these channels can contribute to the habitat quality of the rivers by providing clean, cool water. Conducting riparian plantings alongside the channels would help reduce stream temperature, reduce overland flow, and increase the filtering of the water entering the channels. Plantings on these stable excavated channels are typically successful because the potential for erosion is minimal. Nutria populations should be examined when planning riparian plantings.

*Pudding Creek*

Pudding Creek is a fairly simple creek as described by the parameters measured in this assessment. Because of its fairly unmanaged condition and relatively short length within the study area, its characteristics are quite uniform along its entire length. All of Pudding Creek consists of unexcavated channel reaches. Near its confluence with the Middle Fork of the Willamette, there are two large gravel pits. The dominant vegetation class along its length is hardwoods younger than 40 years. The lower reaches have shrubs as the second most common vegetation type and the upper half has conifers younger than 40 as the second most common vegetation class. Despite the association with common overstory vegetation types, Pudding Creek has less than 33% shading over its entire length. The entire length of Pudding Creek is bordered by undeveloped rural land uses.

Pudding Creek offers some of the healthiest fish habitat characteristics of the tributaries in the study area. Because it feeds directly into the Middle Fork of the Willamette River, it should be considered as a source of potential tributary habitat during high flows or for juvenile salmon. If riparian vegetation remains relatively stable and is allowed to mature, this tributary should remain an excellent source of viable habitat.

*Springfield Mill Race*

The upper portion of the Mill Race, after it enters in from the Middle Fork of the Willamette River, is surrounded by undeveloped rural land. This characteristic persists until 28$^{th}$ Street. After this point, industry dominates along the lower half as it flows along the southern edge of Springfield and then joins with the Willamette River.

Very little of the Mill Race is dominated by exotic vegetation. However, the lower reaches in particular are heavily influenced by surrounding industrial land uses and the city of Springfield. Riparian conditions in these lower reaches consist of pavement, buildings, and gravel lots with some young hardwood trees and shrubs. A long stretch of the Mill Race just above the Mill Pond is bordered by gravel lots. This area coincides with the mills and other industry in the area. The Mill Pond is surrounded by a combination of riparian conditions including bare soil, shrubs, and some young hardwoods.

Almost all the upper portion of the Mill Race riparian vegetation consists of a young hardwood overstory with a native shrub understory. This portion of the Mill Race retains its natural slough character in terms of the interaction between the channel and the riparian vegetation. Despite the predominance of hardwoods in the upper portion of the Mill Race, its entire length has less than 33% cover over it and so water is expected to be warm during the summer. Part of this low cover level may be due to its width and the young age of the hardwoods. Older trees would provide a larger canopy cover.

*Eugene Mill Race*

Despite its industrial history, today almost all the Eugene Mill Race is surrounded by public parks on at least one side. The exception is a stretch of the Mill Race downstream of Franklin Park that is bordered by industrial buildings on both sides of the channel.

The Mill Race is bordered by shrub vegetation for approximately half of its length in a series of separated reaches. The riparian area of the reach upstream of Agate Street is bordered by industry, pavement, and buildings. The riparian vegetation in the upper reach near Franklin Park consists of young hardwood trees.

More than half of the Mill Race has less than 33% cover. These reaches are found in the lower half, particularly where the channel widens into a small pond. Above these reaches, approximate cover is less than 67% except for the small reach near the upper inlet where cover is greater than 67%. This reach is narrow and coincides with the hardwood riparian vegetation.

Water quality and flow is quite limited as a result of historical management practices and the condition of the inlet on the Willamette River. In addition, the outlet of the Mill Race flows underground through a pipe and, therefore, does not permit fish passage.

*Patterson Slough and the Canoe Canal*

Land use next to the western portion of Patterson Slough and the Canoe Canal is primarily public land and parks. The north flowing branch of Patterson Slough is bordered by undeveloped urban land.

Riparian vegetation along Patterson Slough is a mix of young and older hardwoods. Older hardwoods (>40 years) exist at the end of the northward extending channel of the slough. Younger hardwoods (<40 years) make up the southern part of that channel. Both young and older stands have native shrubs as their understory community. The riparian vegetation community of the western channel of Patterson Slough and the Canoe Canal is predominantly grass and shrubs. Exotic vegetation makes up very little of this focus area.

The slough and the Canoe Canal have less than 33% cover over their entire lengths.

*Jasper Road, Oxley, and Berkshire Slough*

Jasper Road Slough lies between the Middle Fork of the Willamette River (to the west) and Jasper Road (to the east). Its confluence lies almost directly under the power lines that cross over the Middle Fork. Oxley and Berkshire Sloughs flow into the Coast Fork of the Willamette River west of I-5 and outside the original study area boundaries near Seavey Loop.

A large portion of land adjacent to these sloughs is rural and undeveloped. Remaining adjacent land use is agricultural. A small portion of Jasper Road Slough parallel to Jasper Road is used as park and other public land as is a small portion of Oxley Slough next to the abandoned gravel pit near its confluence with the Coast Fork.

Most of the riparian vegetation on Jasper and Berkshire Slough is young hardwoods interspersed with shrubs in both the understory and as the predominant vegetation in openings between hardwood stands. Grass and shrubs make up the main vegetation types on Oxley Slough. There is very little exotic vegetation in any of these sloughs.

Cover is predominantly less than 33% on all the sloughs except for areas next to Jasper Road on Jasper Slough and next to the abandoned gravel pit on Oxley Slough. In these areas, cover is mostly less than 67% with small areas of greater than 67%.

*Maple Island, Keizer, and Irving Sloughs*

Maple Island, Keizer, and Irving Sloughs are sloughs off the McKenzie River. Because of the methodology used to collect data for the non-river riparian field assessment, riparian vegetation data was collected for Irving Slough and the ponds in Keizer Slough. The remaining channels in Keizer Slough and Maple Island were not assessed with the non-river channel methodology since they are immediate side channels of the river.

Irving Slough sits along High Banks Road west of the McKenzie River past Highway 126 and northwest of Marcola Road. The excavated ponds in the Keizer Slough sit at the bend in the Keizer Slough south of Highway 126 and northeast of High Banks Road. Land use around these excavated ponds is undeveloped rural as is land adjacent to Irving Slough northwest of Marcola Road. The portion of Irving Slough that sits along High Banks Road and up to Marcola Road is bordered by industrial land uses. The far upper reaches of this slough are affected by residential land uses.

Riparian vegetation surrounding the excavated ponds consists of shrubs. Shrubs also line the undeveloped rural portions of Irving Slough. Exotic shrubs are not found around Keizer Slough's ponds. However, exotic shrubs are the dominant vegetation along the portions of Irving Slough south of Marcola Road. Where exotic shrubs fall out, the riparian areas in these reaches consist of paved industrial lots. Just northwest of Marcola Road on Irving Slough, the riparian area consists of young hardwoods. Further up in the residential area, riparian vegetation is made up of grass.

Cover around the excavated ponds on Keizer Slough and along most of Irving Slough is less than 33%. The small areas bordered by hardwood trees on Irving Slough have cover levels less than 67%.

Irving Slough appears relatively disconnected from the McKenzie River both geographically and as a result of the heavy industrial land uses along its lower portions. The portions of this slough which would contribute adequate fish habitat sit above these industrial influences and are further removed from the McKenzie River by the slough's northwest orientation. Because Keizer slough channels connecting the excavated ponds to the slough and the McKenzie River were not examined, the role of these ponds in providing fish refuge and habitat remains unclear. However, adjacent land uses do not indicate significant potential effects to pond condition and,

riparian vegetation appears healthy. These ponds could provide adequate habitat if they are linked to the McKenzie River via a healthy channel system.

### 2.2.12 Conclusions, recommended actions, and information gaps for non-river waters

Riparian areas alongside non-river waters in the study area, as a whole, are composed of a relatively diverse but young vegetation community. The type of vegetation next to a particular waterway appears to be a function of the adjacent land use, management actions associated with the land use, and, less commonly, the historical vegetation type common to the area.

Grass/weeds and exotic shrubs represent a large component of non-river channel riparian vegetation. The grass/weed community is similar in form and function to the historic upland prairie vegetation type, but the species composition between current and historical grass communities is quite different. In addition, channel processes, such as flooding, deposition, and erosion, affecting current and historic prairie-type riparian areas differ greatly.

Hardwood tree species and shrubs are also common alongside study area channels. However, these species are almost entirely younger than 40 years old, often mixed with non-native ornamental species, and do not extend for significant distances from the channel border. Their shading and large wood contribution levels are limited.

Social and cultural factors within the urban environment, such as safety, aesthetics, and limited resources encourage the persistence of non-native grass and weeds over native grasses, perennials, shrubs and trees. Within the Eugene and Springfield study area, the influence of these factors are apparent in the existing riparian vegetation composition along most non-river waterways. Amazon Creek riparian vegetation, for example, is managed by mowing the upper banks and bank tops within the public park areas (Guay et.al. 2000). During the field assessment, mowing was observed along the Q Street Floodway as well. Though mowing can be used as a management tool for some native prairie species, in this park setting, regular mowing does not allow for the development of native grass seed heads and tends to create a homogenous plant community. Throughout the study area, channels and ditches flowing alongside roads, parks, and residential or commercial lots are commonly managed by mowing or other control measures for traffic visibility, lawns or ordered landscapes, or to control pests such as rodents.

In addition, resource constraints may limit proactive management with native plant restoration projects along waterways in undeveloped urban or industrial areas. With abundant exotic reproductive sources nearby (e.g., seeds, rhizomes), not actively managing urban riparian areas facilitates the introduction and persistence of exotic species such as Armenian blackberry and reed canary grass.

Other than a few exceptions, current non-river channel riparian areas do not appear to have the necessary characteristics that allow them to interact with waterways in ways that encourage healthy fish habitat. Limiting factors are abundance of exotics, young plant age, limited width, and basin hydrology and channel form management practices. We would suggest that immediate

efforts be focused on areas where exceptions to these factors exist, such as on Cedar Creek, Pudding Creek, and slough reaches.

**Recommendations:**

In order to increase the productive interaction of the study area's riparian vegetation with waterways that will promote fish habitat either locally or in reaches downstream, the following suggested general activities are proposed:

1. In order to increase the age diversity of overstory species, allow young hardwood stands to mature. This will increase the likelihood of improving riparian function in terms of shade, large woody debris inputs, and wildlife habitat.

2. Because native grass, shrub, and tree species grow well within the study area, focus on using native plants in revegetation efforts and, as much as possible, on management strategies that mimic historic habitat conditions that supported these plants through flooding.

3. Because an important concern is to offer as much potential habitat to salmonids as possible, focus monitoring, naturalization of flow regimes, and water quality clean-up efforts on channels which currently have the greatest potential to provide salmonid habitat. These are typically unexcavated channels that are closest to the larger rivers. These include, in order of importance:

- Cedar Creek
- Pudding Creek
- Maple Island and Keizer Slough
- Patterson Slough
- Jasper Road, Oxley, and Berkshire Slough

If restoration monies become available, certain channels within the study area would appear to respond more quickly and with greater habitat results than others. Channels that may be suitable for restoration efforts include:

- Springfield Mill Race
- Lower reaches of Willow Creek

4. Natural and constructed ponds that might be suitable for Chinook rearing and the habitat needs of other native fish will be those that are adjacent to the larger rivers or that are closely connected with non-river channels with beneficial habitat conditions. These ponds exist near or are associated with sloughs. Patterson Slough, Keizer Slough, and Oxley Slough all contain such ponds.

5. Peak flow increases due to urbanization cause fish to be displaced in the high-velocity water. Such peak flow increases can be tempered by including well-designed retention basins during initial development and by widening previously-channelized stream channels through

excavation.

Information gaps:
None